A FURTHER STUDY OF THE RELATION OF HOUSING TO PULMONARY TUBERCULOSIS. REPORT ON 18,891 CASES.[1]

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In November, 1918, the author reported a study of the "Relation of Housing to Pulmonary Tuberculosis, with a Report on 36,062 Cases.[2]" The subject is of great importance at this time, and there has been little written upon it in this country. As the author has had numbers of requests to continue his researches, it has been deemed advisable to publish the results in another series of 18,891 cases. In the first report it was emphasized that, if the houses of the poor are improved, the morals to an important extent will be improved, and in so doing the health and the relative efficiency will be benefited.

We must profit by the example of other nations and be inspired to make possible the pursuit of happiness for our huge army of struggling toilers. We must recognize the need as an economic rather than a philanthropic one; we must appreciate the ineffectiveness of our elaborate school systems in making good citizens when the influence of the home is opposed to it; we must recognize the evils incident to bad housing. We must also keep sound and strong the large foreign element which is being constantly woven into our social fabric. Their foreign ideals must be raised to American standards of citizenship, and that cannot be done under the present housing conditions of the poor and dependent, which obtain now in most districts to which they are generally drawn.

So long as there is no specific cure for tuberculosis we have no means of combating the disease except by adjusting environment, increasing the power of resistance and producing conditions favorable to the prevention and cure of the disease. There can be no doubt that fresh air, proper feeding, cleanliness of person and surroundings, rest, tranquillity of mind, careful regulation of the habits of the patient and regulated exercise are the factors on which a cure is based. They may therefore be considered as remedies. So long as there is poverty, with all its accompaniments, bad housing, insufficient nourishment, unsanitary conditions of industry, ignorance and many other evils undermining the welfare of society there will be tuberculosis, with the usual results of suffering, deterioration and premature death. The hope for better days lies not only in the prevention of the disease but in the eradication of the causes and the existing conditions that influence the spread of tuberculosis.

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[2] Reckord, Frank F. D.; Am. Jour. Med. Sc., November, 1918, No. 5, clvi, 670.

As the evils of housing are so largely corrected by educational methods, we cannot hope to correct them without the assistance of all educational factors. We are beginning to do what should have been undertaken a long time ago, to impress upon the youth while in school the essential lessons of right living.

Children are susceptible very early in life to public health education, and if the elementary foundations of sanitary consciences are well laid in the schools, these pupils, when fully grown, will be the sanitary educators of the next generation.

In the study of these cases the 18,891 cases have been divided into two groups, of 10,340 and 8551 respectively:

In the former series:

247	families had	1	member,	representing	247	members.
681	"	2	members,	"	1362	"
1288	"	3	"	"	3864	"
1565	"	4	"	"	6260	"
1624	"	5	"	"	8120	"
1437	"	6	"	"	8622	"
1034	"	7	"	"	7238	"
774	"	8	"	"	6192	"
738	"	9	"	"	6642	"
122	"	10	"	"	1220	"
83	"	11	"	"	913	"
32	"	12	"	"	384	"
18	"	13	"	"	234	"
15	"	14	"	"	210	"
7	"	15	"	"	105	"
5	"	16	"	"	80	"
6	"	18	"	"	108	"
1	"	19	"	"	19	"
1	"	21	"	"	21	"
1	"	30	"	"	30	"

661 families, members not stated.

Thus the sum total, not including the 661 families where members were not stated, represents 9679 families and 51,871 members, or an average number of persons to one family of 5.4 members.

In the second series, comprising 8551 cases:

194	families had	1	member,	representing	194	members.
527	"	2	members,	"	1054	"
988	"	3	"	"	2964	"
1286	"	4	"	"	5144	"
1370	"	5	"	"	6850	"
1210	"	6	"	"	7260	"
899	"	7	"	"	6293	"
650	"	8	"	"	5200	"
649	"	9	"	"	5841	"
66	"	10	"	"	660	"
35	"	11	"	"	385	"
32	"	12	"	"	384	"
15	"	13	"	"	195	"
25	"	14	"	"	350	"
12	"	15	"	"	180	"
3	"	16	"	"	48	"
2	"	17	"	"	34	"
3	"	18	"	"	54	"
1	"	19	"	"	19	"
5	"	20	"	"	100	"
1	"	24	"	"	24	"
1	"	27	"	"	27	"
2	"	40	"	"	80	"

575 families, members not stated.

Thus the sum total, not including the 575 families where members were not stated, represents 7976 families and 43,340 members, or an average number of persons to one family of 5.4 members.

In the group of 36,062 cases previously reported the average number of persons to a family was 5.2 members.

The number of rooms per family is an important study. Considering this problem in the first series of cases.

985	families	occupied	1 room,	representing	985	rooms.
2674	"	"	2 rooms,	"	5348	"
3523	"	"	3 "	"	10569	"
1523	"	"	4 "	"	6092	"
519	"	"	5 "	"	2595	"
200	"	"	6 "	"	1200	"
48	"	"	7 "	"	336	"
23	"	"	8 "	"	184	"
12	"	"	9 "	"	108	"
0	"	"	10 "	"	0	"
3	"	"	11 "	"	33	"
1	family	"	14 "	"	14	"

820 families occupied rooms, number not stated.

The sum total of families, not including those in which the number of rooms was not stated, is 9511 and the number of rooms amounts to 27,464; making an average number of 2.8 rooms per family.

In the second series:

743	families	occupied	1 room,	representing	743	rooms.
2099	"	"	2 rooms,	"	4198	"
3021	"	"	3 "	"	9063	"
1237	"	"	4 "	"	4948	"
463	"	"	5 "	"	2315	"
165	"	"	6 "	"	990	"
38	"	"	7 "	"	266	"
18	"	"	8 "	"	144	"
13	"	"	9 "	"	117	"
2	"	"	10 "	"	20	"
2	"	"	11 "	"	22	"
1	"	"	12 "	"	12	"
1	"	"	13 "	"	13	"
2	"	"	15 "	"	30	"
2	"	"	18 "	"	36	"
1	"	"	25 "	"	25	"

743 families occupied rooms, number not stated.

The sum total of families, not including the 743 in which the number of rooms was not stated, is 7808, and the number of rooms amounts to 22,942, making an average number of 2.9 rooms per family.

In the 36,062 cases reported the number of rooms amounted to 102,674, or an average number of 2.8 per family. So the average number of rooms per family may safely be taken as 2.8 per cent.

In this connection it is next important to know the number of persons in the family compared with the number of rooms occupied.

In the first group it was found that:

224	cases having	1 member	to a family occupied	1 room.
242	" "	2 members	" "	1 "
214	" "	3 "	" "	1 "
133	" "	4 "	" "	1 "
89	" "	5 "	" "	1 "
33	" "	6 "	" "	1 "
23	" "	7 "	" "	1 "
15	" "	8 "	" "	1 "
12	" "	9 and over		

Total, 985 cases, having from 1 up to 9 members and over occupied 1 room.

Just as interesting are the data concerning the number of people that lived in 2 rooms:

9	families having	1 member	to a family occupied	2 rooms.
242	" "	2 members	" "	2 "
478	" "	3 "	" "	2 "
568	" "	4 "	" "	2 "
476	" "	5 "	" "	2 "
385	" "	6 "	" "	2 "
224	" "	7 "	" "	2 "
162	" "	8 "	" "	2 "
119	" "	9 and over	" "	2 "

Total, 2663 families, having from 1 up to 9 members and over, occupied 2 rooms.

Continuing the study I find that 3519 families made up of 1 to 9 members and over, abode in 3 rooms as follows:

4	families having	1 member	to a family occupied	3 rooms.
130	" "	2 members	" "	3 "
414	" "	3 "	" "	3 "
570	" "	4 "	" "	3 "
676	" "	5 "	" "	3 "
630	" "	6 "	" "	3 "
431	" "	7 "	" "	3 "
284	" "	8 "	" "	3 "
380	" "	9 and over	" "	3 "

From the above information it will be noted that 7167 families out of the total 9511 under consideration in the group of 1 up to 9 and over membership, or 75.3 per cent., occupied from 1 to 3 rooms. In the study of 36,062 the percentage of those living in 1 to 3 rooms was 74.5 per cent., thus showing a marked similarity.

Of the remaining 2344 families, 1523, or 16 per cent., composed of the same number of members as given, occupied 4 rooms, while 826, or 8.7 per cent., lived in 5 rooms and over.

From this compilation of figures this interesting and striking summary is obtained:

Total number of rooms occupied by families of 9511 patients, the number of whose rooms is given . . .	27,464 rooms
Membership of families of 9679 patients, 5.4 members to the family	51,871 persons
Average number of persons to each room	1.9 "
Average number of rooms to each family, 5.4 members .	2.8 rooms.

TABLE I.—SOCIAL STATISTICS CONCERNING THE 10,340 CASES OF PULMONARY TUBERCULOSIS. TABLE SHOWING NUMBER OF PERSONS COMPARED WITH NUMBER OF ROOMS OCCUPIED.

Occupants:	Total.	Rooms.					
		1	2	3	4	5 and over	Unstated.
Total . .	10340	985	2674	3523	1523	806	829
Unstated .	661	0	11	4	2	8	636
1 . . .	247	224	9	4	1	0	9
2 . . .	681	242	242	130	26	9	32
3 . . .	1268	214	478	414	104	43	35
4 . . .	1565	133	568	570	189	73	32
5 . . .	1624	89	476	676	267	88	28
6 . . .	1437	33	385	630	253	110	26
7 . . .	1054	23	224	431	221	119	16
8 . . .	774	15	162	284	193	114	6
9 and over	1029	12	119	380	267	242	9

Total number of rooms occupied by families of 9511 patients the number of whose rooms is given . . .	27,460 rooms
Membership of families of 9679 patients, 5.4 members to the family	51,871 persons
Average number of persons to each room	1.9 "
Average number of rooms to each family of 5.4 members	2.8 rooms

Taking up the same problem of number of persons in family compared with the number of rooms occupied, in the second group of 8551 cases, which has been carried out much further than the preceding data, following a suggestion by Dr. Raymond Pearl, of the Johns Hopkins University, of Baltimore, we find that:

164 cases having 1 member to a family occupied 1 room.
195 " " 2 members " " 1 "
149 " " 3 " " " 1 "
97 " " 4 " " " 1 "
57 " " 5 " " " 1 "
46 " " 6 " " " 1 "
22 " " 7 " " " 1 "
6 " " 8 " " " 1 "
2 " " 9 " " " 1 "
2 " " 11 " " " 1 "
1 " " 12 " " " 1 "
Total, 741 families, composed of 1 up to 12 members occupied 1 room.

There were 2095 families, composed of 1 to 14 members quartered in 2 rooms as follows:

4 families having 1 member to a family occupied 2 rooms.
178 " " 2 members " " 2 "
351 " " 3 " " " 2 "
429 " " 4 " " " 2 "
375 " " 5 " " " 2 "
320 " " 6 " " " 2 "
228 " " 7 " " " 2 "
120 " " 8 " " " 2 "
73 " " 9 " " " 2 "
7 " " 10 " " " 2 "
7 " " 11 " " " 2 "
2 " " 12 " " " 2 "
2 " " 13 " " " 2 "
1 " " 14 " " " 2 "

More astonishing is the information relative to those who lived in 3 rooms:

6	families having	1	member	to a family occupied	3	rooms.
79	“ “	2	members	“ “	3	“
353	“ “	3	“	“ “	3	“
498	“ “	4	“	“ “	3	“
616	“ “	5	“	“ “	3	“
484	“ “	6	“	“ “	3	“
348	“ “	7	“	“ “	3	“
311	“ “	8	“	“ “	3	“
278	“ “	9	“	“ “	3	“
14	“ “	10	“	“ “	3	“
7	“ “	11	“	“ “	3	“
6	“ “	12	“	“ “	8	“
5	“ “	13	“	“ “	3	“
3	“ “	14	“	“ “	3	“
1	“ “	15	“	“ “	3	“
1	“ “	18	“	“ “	3	“
1	“ “	19	“	“ “	3	“
1	“ “	40	“	“ “	3	“

Total, 3012 families, made up from 1 to 40 members, occupied 3 rooms.

From this information it will be noted that of this series of 8551 cases, of which 743 gave no data as to rooms occupied (thus leaving 7808), there were 5848 families of 1 up to 40 membership, or 74.8 per cent. that occupied 1 to 3 rooms.

Of the remaining 2060 families, 1234, or 15.6 per cent., composed of 1 to 27 members, occupied 4 rooms, while 826 families, or 10.5 lived in 5 up to 25 rooms.

From this compilation of figures this interesting summary is obtained:

Total number of rooms occupied by families of 7808 patients, the number of whose rooms is given . . .	22,942 rooms
Membership of families of 7976 patients, 5.4 members to the family	43,340 persons
Average number of persons to each room	1.9 “
Average number of rooms to each family of 5.4 members	2.9 rooms

The author believes that the above study will be convincing and that the figures as to the average number of members to a family, the number of persons to a room and the average number of rooms to a family may be taken as a unit of comparison, as there is a marked similarity in the three series amounting to 54,953 cases.

Not only should the home conditions be carefully studied, but also the effect of occupational environment. The contributory factors in the development of tuberculosis in those employed in the industries are no different in kind from those outside the workshop. The only difference is in degree. When in an industry some factor is intensified, or there is a combination of factors, we say there is an occupational hazard.

Tuberculosis following a long period of exposure to injurious conditions is by far the most common history in all but a small number of cases in which the hazards of occupation play an important part.

TABLE II.—SOCIAL STATISTICS CONCERNING THE 8551 CASES OF PULMONARY TUBERCULOSIS. TABLE SHOWING NUMBER OF PERSONS COMPARED WITH NUMBER OF ROOMS OCCUPIED.

—	Total	Rooms.																
Occupants.		1	2	3	4	5	6	7	8	9	10	11	12	13	15	18	25	Unstated.
Total .	8551	743	2090	3021	1237	463	165	38	18	13	2	2	1	1	2	2	1	743
Unstated	575	2	4	9	3	0	5	0	1	1	0	0	0	0	0	0	0	550
1 .	194	164	4	6	1	1	0	0	0	0	0	0	0	0	0	0	0	18
2 . .	527	195	178	79	30	6	2	1	0	0	0	0	0	0	0	0	0	36
3 . .	988	149	351	353	82	24	5	2	0	0	0	0	0	0	0	0	0	22
4 . .	1286	97	429	498	162	53	7	3	3	0	0	0	0	0	0	0	0	34
5 . .	1370	57	373	616	203	75	16	5	0	1	0	0	0	0	0	0	0	24
6 . .	1210	46	320	484	231	65	31	8	0	1	0	0	0	0	0	0	0	24
7 . .	899	22	228	348	178	72	27	2	1	1	1	0	0	0	0	0	0	19
8 . .	650	6	120	311	120	52	22	3	3	1	0	1	0	0	0	0	0	11
9 . .	649	2	73	278	184	70	30	3	2	4	0	0	0	0	0	0	0	3
10 . .	66	0	7	14	14	12	8	4	4	1	1	0	0	0	0	0	0	1
11 . .	35	2	7	7	8	5	2	0	1	2	0	1	0	0	0	0	0	0
12 . .	32	1	2	6	9	5	3	3	2	0	0	0	0	0	1	0	0	0
13 . .	15	0	2	5	4	2	1	1	0	0	0	0	0	0	0	0	0	0
14 . .	25	0	1	3	2	14	1	2	0	1	0	0	0	0	1	0	0	0
15 . .	12	0	0	1	2	5	3	0	0	0	0	0	0	0	0	0	1	0
16 . .	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
17 . .	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
18 . .	3	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
19 . .	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 . .	5	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1
24 . .	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
27 . .	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
40 . .	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0

Total number rooms occupied by families of 7808 patients, the number of whose rooms is given	22,942 rooms
Membership of families of 7976 patients, 57.4 members to the family	43,340 persons
Average number of persons to each room	1.9 "
Average number of rooms to each family of 5.4 members	2.9 rooms

One of the most harmful factors is dust; dusts may be divided according to their physical character as follows:

(*a*) Cutting dusts, formed of minute, hard, crystallized particles which have sharp, cutting and pointed edges. These dusts are composed of iron, or steel, of stone, of sand, or glass, of dried silicates in earthenware, of lime, of pearl.

(*b*) Irritant dusts, derived from woods, from ivory, from textile fabrics, fluffs of wool, of silk, of cotton, of flax and of hemp, from hair, from clay.

(*c*) Inorganic poisonous dusts, derived from some poisonous chemical compound used for coloring artistic products or for preserving organic substances, such as furs. These dusts are charged with arsenical salts.

(*d*) Soluble saline dusts, derived from soluble crystallized substances used for dyeing purposes; sulphate of iron and copperas yield dusts of this class.

(*e*) Organic poisonous dusts, which are thrown off during the making up of tobacco into cigars and snuff. These dusts carry with them particles of the dried tobacco plant.

(*f*) Obstructive and irritating dusts composed of carbon, of fine particles of coal dust, of scrapings of carbon or of soot, of rouge and of flour.

Most of the recent studies on inorganic dust are convincing that metallic and siliceous dusts are the most potent causes of pulmonary fibrosis. The latter is most important because more frequently encountered. The second report of the British Royal Commission on Metalliferous Mines and Quarries (1914) quote experiments of Beattie as follows:

"Certain mineral dusts, such as coal, clay, cement, were not shown by experiment to be injurious. Other dusts, *e. g.*, silica, quartz, flint, sandstone, are injurious, as are also carborundum and emery. After careful consideration, therefore, we feel justified in concluding that, even although further investigation should disclose other dusts as injurious, the dust of fine crystalline silica is especially injurious and is more potent cause of fibrosis."

The commission was further of the opinion that inorganic dusts may be grouped in two classes:

1. "Dusts, the inhalation of which has not so far been shown to be associated with any marked increased mortality from respiratory diseases, to this class belong coal, steel, slate, iron ore, clay, limestone, plaster of Paris and cement." . (2) "Dusts, the inhalation of which is associated with excessive mortality from respiratory diseases, and especially from phthisis, to this class belong quartz, quartzite (*i. e.*, ganister and buhr stone), flint and sandstone."

The hard, gritty dust composed of sharp and jagged particles are the ones to be especially feared. The least important of the inorganic dusts is soot. The grinding trade includes a large variety of employments, of which metal grinding by either the dry or wet process is hygienically as well as industrially the most important. The grinding of metal probably involves as much exposure to decidedly health-injurious conditions as does any other employment, if not more so. Chiefly as the result of the inhalation of relatively large quantities of fine metallic dust, and not inconsiderable quantities of fine mineral dust, the mortality from pulmonary tuberculosis in this occupation is decidedly above the normal for occupied males generally. The size of the individual particles plays an important part. The finer the dust, the more dangerous, as it is only the very finest particles which gain access to the lungs. According to Oliver, so far as the two methods of grinding cutlery are concerned, the dry method is, from a health point of view, the more dangerous to the workers. The dust is dry and is in the form of a very fine powder, which readily reaches the lungs owing to the attitude of the men when at work. Steel grinders sit astride the grinding stone on a saddle, and as they lean forward keeping close to their work, they cannot but inhale some of the dust, which is a mixture of steel and stone. Forks and needles are generally ground by the dry method; knives, scissors, and razors by the wet method. Some are ground by both methods, *e. g.*, the backs of razors and scissors are ground by the dry method and the remainder of the blade by the wet. It was in 1865 that Dr. T. C. Hall, of Sheffield, drew attention to the high death-rate of steel grinders from pulmonary tuberculosis. The average age at death of steel grinders was at this period only twenty-nine years, but of late this has improved. His statistics referred to dry grinding. In wet grinding the running stone passes through a thin layer of water in a trough below the stone, so that, as its surface is always kept wet, comparatively little dust is given off during the process of grinding; but while the atmosphere is clearer of dust the floors and walls of the workshop are damp and cold. It is no uncommon thing to find men engaged in different processes in one large room, so that the dust that is generated affects not only the workman sitting at his own grinding stone but the other inmates of the room as well.

In the case of a worker exposed to unusual quantities of inorganic dust the majority of the particles are, for a varying length of time, arrested by the moist surface of the mucous membrane, by the action of the ciliated epithelium and by the phagocytes. Sooner or later these defensive forces weaken and finally the dust passes into the lymph channels and also along the finer bronchi until it reaches the parenchyma of the lungs. As a foreign substance it then sets up a chronic inflammatory process.

The experience of Landis,[3] Arlidge[4] and others is that the anterior and inferior marginal portions of the lungs, where expansion is most free, are always less affected than the posterior and apical portions. Radiographic evidence shows also that change frequently is slightly more advanced in the right lung than in the left.

The observation of a British departmental committee upon respiratory diseases, and in particular bronchitis, pneumonia and tuberculosis and their relation to occupation exposure, were that "pulmonary disease manifests itself in three kinds or forms: as ordinary tuberculous phthisis, acute or chronic; as fibroid phthisis, and as a mixed form when a tuberculous process is ingrafted sooner or later upon the fibroid. Fibroid phthisis is always a slow disease. It consists in a chronic reactive inflammation around the many minute foci of dust inhalation, which by coalescence gradually invades large areas, impairing and strangling the proper lung tissues in corresponding measure. Again a lung so impaired is very liable to harbor bacilli, especially the tubercle bacilli, by the influence of which it may be still further destroyed." Frequently it is most difficult to determine whether the condition is tuberculous or not, and even the roentgenograms may be difficult to interpret. Patients are frequently admitted to sanatoria with a diagnosis of pulmonary tuberculosis, but what they are really suffering from is a diffuse fibrosis of the lungs and dilatation of the bronchi.

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[3] Landis, H. R.: Jour. Indus. Hyg., July, 1919, No 3, i, 117–130.

[4] Arlidge, J. T.: Hygiene-Diseases and Mortality of Occupation, London, 1892, p. 251.

Another thing that cannot be emphasized too strongly is the evident difference in resistance of individuals to dust. Two men may be working at the same occupation and under the same environment, and yet one will show marked fibrosis and the other may show little change.

From the bacteriological studies of Sweaney and MacLane[5] in testing samples of dust it was found that of 134 samples taken from rooms where open cases of tuberculosis were being treated 12 were positive. Of 18 samples taken from a county jail 3 were positive. Seven positive samples were found in single and double rooms facing north while only two were found in rooms facing south. The greatest percentage of positive samples were found in places where the greatest number of open cases were being treated. It may thus be readily appreciated what a menace dust is, generally as it is such a convenient carrier of the tubercle bacilli.

The factor of ventilation is relative; the more dust the more ventilation required. It is just as important that men, women and children receive proper ventilation during the day as at night. A small amount of dust or fumes may be very dangerous if there is no provision for fresh air. Overcrowding in a work room is a menace. Excessive humidity coupled with extremes of heat or cold tend to reduce bodily resistance; and this makes another hazard for the workman.

Along with exposure to dust and improper ventilation, overcrowding, the posture of the workman, nervous strain and the fatigue of too swift a pace or too long hours are some of the more important factors to be considered in connection with the effect of occupational environment.

In the 10,340 cases of our first series there were 5815 males and 4525 females. From the occupational standpoint the males under occupational age totaled 805 (native 768, foreign 36, unstated 1); those with no occupation, 1707 (native 1023, foreign 684); those occupied 3303 (native 1972, foreign 1331); grand total 5815.

Studying those occupied it was found that the engineers and surveyors led the professional group; book-keepers, clerks, and copyists maintain their usual lead in the clerical and official group, commercial travelers in the mercantile and trading group, saloon-keepers and bartenders in the public service group and barbers and hair-dressers in the personal service group. The foreign laborers outnumber the native in the laboring and servant group. In the manufacturing and mechanical industry group the machinists come first with the steel-workers, tailors, mill and factory operatives (textile), carpenters and joiners, stationary engineers and firemen, clock and watch repairers, jewelers, boot and shoemakers, painters and glaziers, plumbers, gas and steam fitters, blacksmiths, butchers, cigarmakers and tobacco workers following in order named.

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[5] Sweany and MacLane: Illinois Med. Jour., 1919, No. 6, xxxix, 302.

In the agricultural and transportation group the miners and quarrymen come first, followed by draymen, hackmen, teamsters, steam railroad employees and farmers, planters and farm laborers. The laboring and manufacturing groups lead with the largest numbers respectively.

In regard to the female occupations the housewife predominates, followed in the gainful occupation class by servants, mill and factory operatives, bookkeepers, clerks, copyists, dressmakers, seamstresses, laundresses, stenographers and typewriters in order named. Those under occupational age numbered 926 (native 883, foreign 43); those with no occupation 944 (native 778, foreign 166); all occupations total 2655 (native 1884, foreign 771).

In the second series of 8551 cases there were 752 native, 29 foreign and 1 unknown males who were under occupational age. Under the heading of no occupation appears 1000 native and 609 foreign, 4 unknown. In the group of occupations 1444 were native, 995 foreign and 6 unknown. Of the 796 females under occupational age 760 were natives, 36 foreign; there were 765 with no occupation (645 native, 120 foreign); those occupied were 2147, with 1521 native and 623 foreign, 3 unknown.

Of those occupied there is a similarity in findings, but in the personal service group it is interesting to note that next to the barbers and hair-dressers follow closely the soldiers, sailors and marines and not far behind the policemen, watchmen and detectives.

The Pennsylvania State Department of Health has a model housing ordinance for cities and boroughs to follow in enacting ordinances.

1. It shall be the duty of the board of health to investigate the sanitary conditions of tenement, rooming, lodging and boarding houses, and when the same are found not to be in conformity with the requirements of this ordinance, or in the opinion of the board of health to be a menace to those occupying the same, or employed therein, or to be overcrowded, to condemn the same and to notify the owners or agents thereof in writing, setting forth the noncompliance with requirements of this ordinance, or the insanitary or overcrowded conditions thereof and specifying in writing the changes or alterations which shall be made thereto for the purpose of relieving such conditions and further specifying the time within which such changes or alterations shall be completed or overcrowding relieved.

2. For the purpose of this ordinance the several classes of buildings referred to herein are defined as follows:

(*a*) A lodging house shall mean any building or portion thereof in which five or more persons are furnished with sleeping accommodations for a single night either for hire or for charity.

(*b*) A rooming house shall mean any building or barracks or portion thereof in which persons are received, housed or lodged either for hire or for charity.

(*c*) A boarding house shall mean any building or portion thereof in which persons are received, housed, lodged or furnished with meals for hire.

(*d*) A tenement shall mean any building or portion of a building or block of buildings which is occupied by two or more families who have a common right in the halls, stairways, cellars and plumbing, yard or any one of them. Tenements shall include apartment houses apartment hotels, flats, two- and three-family houses, and any building not otherwise described which is used for multiple habitation where any portion thereof is used in common.

3. All buildings of the classes specified herein located on or adjacent to a highway in which a public water main is laid shall have the public water supply distributed through the building as to furnish an adequate quantity of wholesome water, with reasonable facilities for drinking and washing purposes for the occupants thereof; provided, that in tenements each family shall be furnished with water supply for their separate use. All buildings of the classes specified herein so located that a public water supply is not accessible, shall be furnished with an approved private water supply distributed in an approved manner.

4. All buildings of the classes specified herein located on or adjacent to a highway in which a public sewer is laid shall have the drainage system of the building connected thereto, and there shall be furnished adequate and sanitary toilet facilities for separate use of each family. All buildings of the classes specified herein so located that a public sewer is not accessible shall be furnished with a substantial and sanitary type of cesspool, privy or other device, constructed, installed and maintained in an approved manner; provided, that in tenements each family shall have separate toilet facilities.

5. All rooms used for sleeping purposes in buildings of the classes specified herein shall have at least 600 cubic feet of air space or 70 square feet of floor area for each occupant of said room; provided, that no cellar, basement, lower story or any portion of a building of which one-half of the height from the floor to the ceiling is below the level of the ground adjoining, shall be used for sleeping purposes.

6. All buildings of the classes specified herein shall be so located that reasonable open space or spaces furnishes natural light and air to the windows of each room in said buildings. Each room in said buildings used for living or sleeping purposes shall have a window

or windows opening directly to the outside and furnished with sash so constructed and maintained that they may be easily opened to provide ample ventilation. Said windows shall be proportioned as follows:

MINIMUM AREA OF WINDOWS.

Number of persons occupying room.	Window area in square feet per capita.	
	When window is in one wall.	When windows are in opposite walls.
1	10	8.0
2	9	7.0
3	8	6.5
4 or more	7	6.0

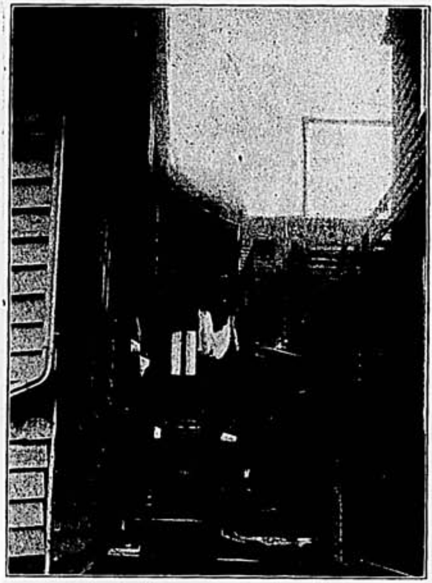

FIG. 1.—Extreme overcrowding of land.

7. Any building of the classes specified herein or any portion thereof shall not be occupied if it is in such condition, that in the judgment of the board of health sanitary methods of living cannot be maintained. If the board of health deems it necessary in the interest of the public health they shall notify in writing the owner or agent of any such building describing the insanitary conditions that exist therein requiring the same to be abated within a specified

time and that after the expiration of the time specified the premises shall not be occupied unless they be placed in an approved sanitary condition. If at the expiration of the time given in the said notice its requirements have not been complied with, the said building shall be vacated and the board of health shall post a sign or placard upon the property in a conspicuous place, stating that the building or any part of it, or the premises, as the case may be, is in an insanitary condition and shall not be occupied.

FIG. 2.—Filthy alley—no place for children to play.

8. Whenever notice is given under the provisions of this ordinance, the same shall be served upon the person to make such correction, or his agent, by the duly authorized agent of the board of health, or by mailing a copy of the said notice to the last known address of such person or his agent, and by posting a copy of this notice in a conspicuous place upon the premises affected. The notice and placard or sign stipulated in Paragraph 7 hereof shall not be removed or defaced until its removal is authorized in writing by the board of health.

9. Any person, firm or corporation who shall violate any of the provisions of this ordinance shall upon conviction before any justice

of the peace, alderman or magistrate be fined not less than five ($5) dollars per day or more than twenty-five ($25) dollars per day, for each day during which the premises have been used after the expiration of the time specified in the aforesaid notice of the board of health and also the cost of prosecution.

10. In case any violation of this ordinance also constitutes a violation of an Act of Assembly of Pennsylvania for which a penalty is provided by law, with which penalty the penalty provided by this ordinance may be inconsistent, in such cases the penalty provided by the Act of Assembly shall take precedence and shall be the penalty imposed for such violation.

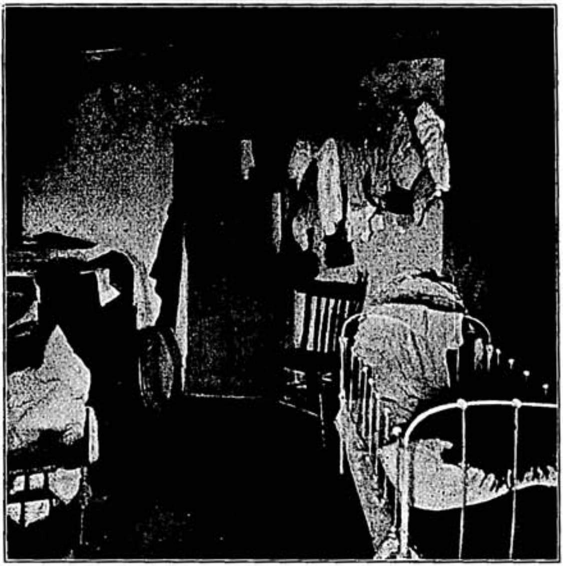

FIG. 3.—Windowless room—occupied by three small children.

11. Whenever in this ordinance the words 'accessible, approved, reasonable, available' or words of like import are used, it shall be understood that the accessibility, approval, reasonableness, availability shall be determined by the Board of Health.

12. All ordinances or parts of ordinances inconsistent herewith are hereby repealed.

Appendix. Housing improvements are primarily directed to the structural features of the building; however, it must be borne in mind that other factors enter into the problem and it may be advisable to add sections to the ordinance covering the following points:

(*a*) That no buildings of the classes specified herein shall be constructed on the rear end of a lot or in conjunction with other buildings unless the said building shall have a full frontage upon a public street and be so located that the said building shall not cut off or interfere with the light and air of any building on the same lot.

(*b*) That no tenement house or lodging house hereafter erected may be occupied where a public sewer is not accessible or where the public street is not sewered, graded and open to public travel.

FIG. 4.—The above picture shows that even in semirural districts, where there would seem to be sufficient sunlight and fresh air for all, conditions exist which practically duplicate the worst overcrowding of our cities.

It must further be borne in mind that the cleanliness of the building and it environments are essential to wholesome living conditions, for example:

(*c*) In tenement houses the owner should be held responsible for the maintenance of the common halls, stairways, cellar, yard, etc., in a cleanly condition.

(*d*) The accumulation of rubbish, ashes, garbage or organic wastes on the premises of tenement houses shall not be permitted.

(*e*) The grounds of tenement houses and lodging houses shall be either paved or graded and drained so that water will not be retained.

These items (c) (*d*) (*e*) may be controlled by adding proper sections to this ordinance or by considering such conditions as public nuisances and the board of health abating them as such.

TABLE III.—CHARACTER OF DWELLINGS OCCUPIED BY 14,365 CASES OF PULMONARY TUBERCULOSIS AND ALLIED CONDITIONS.

Classification.	Sex.	Total.	Private house.	Apartment.	Tenement.	Boarding house.	Institution.	Army camp.	Shanty.	Stable.	Unstated.
		14,365	11,964	864	801	227	415	3	3	2	86
Incipient	M.	1,688	1,452	81	95	21	34	0	0	0	5
	F.	1,669	1,490	77	61	7	32	0	0	0	2
Moderately advanced	M.	3,833	3,076	259	250	93	115	1	3	2	34
	F.	2,628	2,255	167	129	17	46	0	0	0	14
Far advanced	M.	2,869	2,272	188	174	77	146	2	0	0	10
	F.	1,417	1,222	87	47	12	38	0	0	0	11
Glands	M.	114	85	2	19	0	2	0	0	0	6
	F.	131	101	1	20	0	2	0	0	0	4
Other tuberculosis	M.	6	4	1	1	0	0	0	0	0	0
	F.	10	4	1	5	0	0	0	0	0	0

From the above table it will be noted that 11,964 cases, or 83 per cent. lived in private houses. Of course, these houses differ greatly as to the number and size of rooms. We should consider the construction and location of the average private house in the poorer section of our cities—frequently long rows of small, dark houses opening upon courts, thus being deprived of the sunlight and dresh air, and kept in poor repair, subject to damp or wet cellars, poor sanitation, incubators for infections, such as tuberculosis. When it is realized that between 74 and 75 per cent. of families, averaging 5.4 members to a family live in 1 to 3 rooms, it is readily seen how difficult it is to arrange for the management of a tuberculous member and the need of sanatorium treatment in such instances is obvious.

Of these 14,365 cases, 3357 were classified in the incipient stage: 1688 males and 1669 females respectively.

In the moderately advanced stage there were 3833 males and 2628 females, or a total of 6461. The males outnumber the females by 1205.

In the far-advanced class there were 2869 males and 1417 females, or a total of 4286. Here also the males predominated by 1452.

The reason for the preponderance of the males is obvious and has been elaborated upon in the preceding report.

The death-rate from pulmonary tuberculosis in the registration area of the United States for 1917 was 128.9 per 100,000 or a total of 97,047 deaths. In the commonwealth of Pennsylvania the death-rate per 100,000 in 1918 was 128.4, or a total of 11,298 deaths. Investigating the matter in some of the well-known cities of Pennsylvania we find:

Estimated population of a number of cities in Pennsylvania and deaths from pulmonary tuberculosis during 1918. Foreign and negro element of population expressed in percentage.

Cities.	Population.	Foreign, per cent.	Negro, per cent.	Deaths.
Allentown	66,708	12.0	0	88
Altoona	60,757	10.0	..	29
Bethlehem	14,554	6.2	0	13
Bradford	15,789	15.0	0	10
Butler	29,670	17.0	0	22
Carbondale	19,952	17.0	0	10
Chester	42,318	17.3	12.4	86
Coatesville	15,541	13.2	13.7	11
Connellsville	16,299	12.4	0	11
Dubois	15,323	16.8	0	8
Easton	31,172	10.9	0	31
Erie	77,993	22.5	0	130
Harrisburg	74,737	9.8	7.7	71
Hazelton	29,473	23.6	0	20
Johnstown	72,405	27.6	0	64
Lancaster	52,021	6.8	0	60
Lebanon	22,159	6.5	0	24
McKeesport	49,087	29.6	0	35
Meadville	14,132	12.3	0	13
New Castle	42,697	23.8	0	30
Oil City	19,969	13.4	0	15
Pottsville	23,060	10.5	0	38
Pittsburgh	593,300	26.3	4.8	738
Pittston	19,351	29.2	0	14
Philadelphia	1,761,026	24.7	5.5	3389
Reading	119,249	9.2	0	118
Scranton	152,283	27.0	0	124
South Bethlehem	25,512	41.9	0	39
Shenandoah	30,305	40.6	0	18
Shamokin	21,217	14.2	0	20
Sunbury	17,062	2.0	0	15
Williamsport	34,437	7.3	0	31
Wilkes-Barre	77,892	24.0	0	77
York	53,884	3.6	0	56
Steelton	15,968	32.7	9.0	19

DEATH-RATE FROM PULMONARY TUBERCULOSIS PER 100,000 POPULATION DURING 1917. CITIES IN UNITED STATES.

The registration area	128.9
Registration States	126.8
Cities in registration States	138.2
Rural part of registration States	116.6
The registration cities in non-registration States	156.6
All registration cities	140.7

REGISTRATION CITIES OF 100,000 POPULATION OR MORE IN 1910.

Place.	Rate.
Birmingham, Ala.:	
W.	51.0
C.	381.0
Baltimore, Md.:	
W.	148.9
C.	567.4
Boston, Mass.	149.1
Bridgeport, Conn.	153.9
Chicago, Ill.	133.2
Cincinnati, Ohio	211.7
Cleveland, Ohio	151.5
Denver, Col.	222.8
Detroit, Mich.	137.5
Los Angeles, Cal.	179.7
Louisville, Ky.:	
W.	104.2
C.	345.9
Minneapolis	119.2
Memphis, Tenn.:	
W.	115.0
C.	472.0
New Orleans, La.:	
W.	193.0
C.	560.0
Newark, N. J.	146.4
New York	159.6
Bronx Borough	201.1
Brooklyn Borough	145.1
Manhattan Borough	160.9
Queens Borough	154.0
Richmond Borough	184.4
Portland, Oregon	49.9
Philadelphia, Pa.	175.0
Pittsburgh, Pa.	128.5
San Francisco, Cal.	162.4
Scranton, Pa.	69.5
Seattle, Wash.	57.0
St. Paul, Minn.	114.5
Washington, D. C.:	
W.	104.2
C.	345.9

Conclusions. What methods shall be used to improve the home conditions and occupational environment of our people?

1. If the children are to be the sanitarians of the future, there must be systematic health instruction in the public schools. Carrying out this idea the Pennsylvania State Department of Health purposes to furnish data on this subject to the Pennsylvania State Department of Public Instruction for a book which will be used throughout the extensive school system in this State, so that every school child will not only be taught this major branch but will be compelled to pass an examination upon its completion. Also the State Health Department is developing a public health school which is to be conducted by means of the daily and weekly newspapers and is comprised of twenty-four lessons on topics such as tuberculosis, school hygiene, milk, sanitation, the dinner bucket,

colds, flies and others, written in a style to appeal to the public generally. The State will be organized with classes, each community having its secretary, who will manage the affair. It is to be hoped that the children as well as adults thus instructed will not be satisfied to continue to live in an atmosphere or environment, which they can improve by putting into execution some of the knowledge obtained. It is not only important to teach people certain truths, but to see that they make practical use of them. Many of the well-recognized principles of preventive medicines are thoroughly understood by the laity, but their practice is sadly neglected.

2. More publicity is needed, so as to place the needs of a town or city before the general public, who may be ignorant of existing conditions. By the demand of the public many evils, such as overcrowding, improper sanitation and poor ventilation in public places, are eradicated and additions for the public good, such as fresh air schools, are obtained.

3. Greater effort should be made in connection with the establishment of fresh-air schools, and rounding up in the communities and rural districts the children, who are pre-tuberculous or in the active process of the disease and in providing treatment for them. It is hoped that in the future all schools will be conducted on the fresh air plan.

4. It is important and necessary that employers be kept reminded as to their duty to their employees. Rest rooms should be provided where a little recreation and relaxation may be obtained during the lunch hour. In many places firms are providing hot lunches at a reasonable rate to their employees, which does away with the carrying of cold articles of food and likewise provides relaxation at meals under favorable conditions.

5. The establishing of health centers in each of our cities and in representative towns of the rural districts, which shall be the centers of all activities pertaining to the uplift of the community. These centers in Pennsylvania are utilizing the rooms used by the State Clinics and the organizations that are engaged in this work are composed of individuals who are endeavoring to do their share in their particular spheres. Stated meetings are held which are attended by chiefs of the tuberculosis, genito-urinary, child welfare and prenatal clinics, the county medical director and representatives from the health council comprised of the American Red Cross, Associated Charities, Women's Clubs and Societies, Men's Clubs, including the Rotary and Kiwanis Clubs, Chamber of Commerce, Fraternal Organizations, Churches and Newspapers. At these meetings all social problems are considered and plans made to better existing conditions. Nutrition classes are being started and children from twelve to sixteen years of age are taught to cook; also mothers' clubs where lessons in sewing, planning meals and care of the baby

are given; also little mother's leagues where girls are taught how to clothe, feed and bathe the baby.

6. It is important to constantly keep before the public, sick or well, the value of sunlight. Sunlight is needed by all, in fact all measures upon which we rely for the cure of tuberculosis are those which we should recommend to the well in order to make them stronger, happier and more vigorous. In the recent research work of Sweany and MacLane,[6] Chicago, it was shown they found that a suspension of tubercle bacilli in salt solution was killed in twenty minutes in direct sunlight with the rays of the sun at an angle of 50 degrees; five hours in a film of dust in direct sunlight: five days in a film of dust in a south room and seven days in a film of dust in a north room. Soparker[7] has also performed noteworthy experiments, his work consisted in testing the resistance of tubercle bacilli under varying conditions such as sunlight, diffuse daylight and darkness. He found that the tubercle bacilli will live twenty days in moist sputum; three hundred and nine days in the dark; five days in diffuse daylight in dust and two hours in direct sunlight in dust. His work shows clearly that sunlight is the worst enemy of tuberculosis.

7. We recoil in horror from the leper house or the cholera camp, yet the deadliest known hotbed of horrors, the spawning ground of more deaths than cholera, smallpox, yellow fever and bubonic plague combined, is the dirty floor of the dark, unventilated living room, whether in city tenement or village cottage, where children crawl and elders spit. However we may improve the most insanitary house or room, make it habitable for either sick or well, but if we neglect to improve the occupants of the house, all our efforts will be of no avail. Every sanitary housing plan which does not take into account the sanitation or personal hygiene of its occupants must fail. They are inseparable. Sanitation of the house must go hand in hand with personal family hygiene.

8. Instead of Nature being able to cure tuberculosis unaided, as a matter of fact she has neither the ability nor the inclination to do anything of the sort. There is no class of patients whose recovery depends more absolutely upon a most careful and intelligent study and regulation of their diet, of every detail of their life throughout the twenty-four hours and of the most careful adjustment of air, food, heat, cold, clothing, exercise, recreation, by the combined forces of sanitation, nurse, and physician. It is only by education and education of the highest type that we have any reasonable prospect of cure.

9. Finally, it is the duty of every physician to influence public opinion, that the evils incident to bad housing, occupational environment and sanitation may be improved, so that the children, the hope of the future, may be given a chance.

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[6] Loc. cit.

[7] Soparker, M. B.: Indian Jour. Med. Research, Calcutta, 1917, iv, 627–650.